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JC914 U.S. PTO
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PTO/SB/05 (4/98)
Approved for use through 09/30/2000. OMB 0651-0032
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))

Attorney Docket No.	5019.7-1
First Inventor or Application Identifier	Thomas A. Cain
Title	See 1 in Addendum
Express Mail Label No.	EL594728845US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)*
(Submit an original and a duplicate for fee processing)

2. [X] Specification [*Total Pages* 16]
(preferred arrangement set forth below)
- Descriptive title of the Invention
- Cross References to Related Applications
- Statement Regarding Fed sponsored R & D
- Reference to Microfiche Appendix
- Background of the Invention
- Brief Summary of the Invention
- Brief Description of the Drawings *(if filed)*
- Detailed Description
- Claim(s)
- Abstract of the Disclosure

3. [X] Drawing(s) *(35 U.S.C. 113)* [*Total Sheets* 3]

4. Oath or Declaration [*Total Pages* 3]
a. [X] Newly executed (original or copy)
b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d))
(for continuation/divisional with Box 16 completed)
i. [ ] DELETION OF INVENTOR(S)
Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

** NOTE FOR ITEMS 1 & 13 IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).*

ADDRESS TO: **Assistant Commissioner for Patents**
Box Patent Application
Washington, DC 20231

JC897 U.S. PTO
09/645900
08/24/00

5. [ ] Microfiche Computer Program *(Appendix)*

6. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
a. [ ] Computer Readable Copy
b. [ ] Paper Copy (identical to computer copy)
c [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

7. [X] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement [ ] Power of Attorney
(when there is an assignee)
9. [ ] English Translation Document *(if applicable)*
10. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
11. [ ] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503)
(Should be specifically itemized)
13. [X] * Small Entity Statement(s) [ ] Statement filed in prior application Status still proper and desired
(PTO/SB/09-12)
14. [ ] Certified Copy of Priority Document(s)
(if foreign priority is claimed)
15. [ ] Other: .....

16. If a **CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
[ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. _____/_____
Prior application information: *Examiner* _____ *Group / Art Unit* _____
For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[X] *Customer Number or Bar Code Label* 23559 *(Insert Customer No. or Attach bar code label here)* or [ ] *Correspondence address below*

Name			
Address			
City	*State*	*Zip Code*	
Country	*Telephone*	*Fax*	

Name (Print/Type)	Wei Wei Jeang	*Registration No. (Attorney/Agent)*	33,305
Signature		*Date*	8/24/2000

Burden Hour Statement: This form is estimated to take 0.2 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

Attachment to PTO/SB/05 (4/98) Utility Patent Application Transmittal

1. System and Method of Dynamic Load Balancing Across Processor Nodes

PTO/SB/19 (1-99)
Approved for use through 09/30/2000. OMB 0651-0031
Patent and Trademark Office: U.S. DEPARTMENT OF COMMERCE

STATEMENT CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) & 1.27(c))--SMALL BUSINESS CONCERN

Docket Number (Optional): 5019.7

Applicant, Patentee, or Identifier: Thomas A. Cain, et al.
Application or Patent No.:
Filed or Issued:
Title: System and Method of Dynamic Load Balancing Across Processor Nodes

I hereby state that I am
- ☐ the owner of the small business concern identified below:
- ☒ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN: Santera Systems Inc.

ADDRESS OF SMALL BUSINESS CONCERN: 2901 Summit Avenue, Suite 100, Plano, Texas 75074

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

- ☒ the specification filed herewith with title as listed above.
- ☐ the application identified above.
- ☐ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:
- ☒ no such person, concern, or organization exists.
- ☐ each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING: David W. Heard

TITLE OF PERSON IF OTHER THAN OWNER: Chief Executive Officer

ADDRESS OF PERSON SIGNING: 2901 Summit Avenue, Suite 100 Plano, TX 75074

SIGNATURE: _____ DATE: August 9, 2000

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of: Thomas A. Cain et al.

Application No.: To Be Determined Group No.: To Be Determined
Filed: 08/24/2000 Examiner: To Be Determined
For: System and Method of Dynamic Load Balancing Across Processor Nodes

Assistant Commissioner for Patents
Washington, D.C. 20231

EXPRESS MAIL CERTIFICATE

"Express Mail" label number EL594728845US
Date of Deposit 08/24/2000

I hereby state that the following *attached* paper or fee

Utility Patent Application Transmittal
Utility Patent Application (16 pages)
Drawings (3 pages)
original Declaration and Power of Attorney
Statement Claiming Small Entity Status
Assignment
Assignment Recordation Cover Sheet
Fee Transmittal
Check No. 13868 for $40.00
Check No. 13869 for $426.00
Postcard

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. section 1.10, on the date indicated above and is addressed to the Assistant Commissioner for Patents, Washington, D.C. 20231.

Vikki R. Colvin

Vikki R. Colvin

Signature of person mailing paper or fee

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SYSTEM AND METHOD OF DYNAMIC LOAD BALANCING ACROSS PROCESSOR NODES

TECHNICAL FIELD OF THE INVENTION

This invention relates to distributed processing, and more particularly, to a system and method of dynamic load balancing across processor nodes.

BACKGROUND OF THE INVENTION

In distributed processing architectures, multiple processing nodes share the work load according to some predefined load balancing algorithm. Conventional methods include round robin or weighted round robin, for example, which assign work to the processing nodes in a static or fixed manner. Furthermore, conventional methods do not fully and effectively utilize the additional processing power of improved processing nodes because the added capability or efficiency of these nodes are typically not taken into account in balancing the work load. For example, a system may include four processing nodes with different processing capacity, perhaps due to the different vintage of the processors, with the new processors having improved capacity. Static load balancing methods do not assign more work to those processor nodes with higher capacity to take advantage of the added computing power. To fully exploit the continuous increases in processing power of newer computer processor designs, work load balancing should allow processor cluster expansions and upgrades with higher capacity processor nodes while not requirement replacement or retirement of existing older processing nodes.

SUMMARY OF THE INVENTION

Therefore, it is desirable to provide a dynamic load balancing methodology which assigns work to multiple processing nodes so that the nodes function at an approximately equal percentage of each node's full processing capacity in order to fully take advantage of the processing capacities of the processing nodes.

In accordance with an embodiment of the present invention, a method of dynamically balancing work among a plurality of processing nodes is provided. The method includes the steps of periodically updating a node occupancy value at each of the plurality of processing nodes, communicating the respective node occupancy value of each processing node to at least one work originator node, storing the node occupancy values of the plurality of processing nodes at the at least one work originator node, and selecting, by the at least one work originator node, a processing node to perform a particular task in response to the node occupancy values of the processing nodes.

In accordance with another embodiment of the present invention, a method of dynamically balancing call processing tasks among a plurality of call processing nodes in a telecommunications switch is provided. The method includes the steps of periodically updating a node occupancy value at each of the plurality of call processing nodes, communicating the respective node occupancy value of each call processing node to at least one work originator node operable to receive incoming calls, storing the node occupancy values of the plurality of call processing nodes at the at least one work originator node, and selecting, by the at least one work originator node, a call processing node to process the incoming call in response to the node occupancy values of the call processing nodes.

In accordance with yet another embodiment of the present invention, a telecommunications system is provided. The telecommunications system includes a plurality of call processing nodes and at least one incoming call receiving node. The plurality of call processing nodes each periodically calculates and updates a respective node occupancy value, and communicates the respective node occupancy value to at least one incoming call receiving node. The at least one incoming call receiving node stores the node occupancy values of the plurality of call processing nodes, and selects

a call processing node to process the incoming call in response to the stored node occupancy values of the call processing nodes.

The present invention thus dynamically balances the processing load of the processing nodes as a percentage or relative to the total capacity. As a result, the work load can be more evenly and more intelligently distributed to fully take advantage the higher capacity of newer and faster computer processing technology. Because the node occupancy information is communicated in the message header of existing message traffic, little or no overhead is expended to accomplish this task. The use of an open loop feedback design versus a closed loop feedback design provides a more flexible load balancing scheme. In addition, each node in the system is able to calculate its own occupancy rate in the manner best suited to that particular node or best for overall system performance.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention, the objects and advantages thereof, reference is now made to the following descriptions taken in connection with the accompanying drawings in which:

FIGURE 1 is a simplified block diagram of a distributed processing system containing work originators and work performers;

FIGURE 2 is a simplified block diagram of a distributed processing system set in a telecommunications environment;

FIGURE 3 is a flowchart of node occupancy value calculation according to an embodiment of the teachings of the present invention;

FIGURE 4 is a flowchart of sending an inter-node message containing a node occupancy value according to an embodiment of the teachings of the present invention;

FIGURE 5 is a flowchart of receiving an inter-node message containing a node occupancy value according to an embodiment of the teachings of the present invention; and

FIGURE 6 is a flowchart of selecting a processing node according to the node occupancy values according to an embodiment of the teachings of the present invention.

DETAILED DESCRIPTION OF THE DRAWINGS

The preferred embodiment of the present invention and its advantages are best understood by referring to FIGURES 1 through 6 of the drawings, like numerals being used for like and corresponding parts of the various drawings.

FIGURE 1 is a simplified block diagram of a distributed processing system containing work originators 10 and work performers 12. Work originators 10 and work performers 12 may be computing platforms, processor-based devices, or any equipment or processes that are capable of carrying out a logical sequence of steps. Work originators 10 may receive requests for work from other devices (not shown) via networks and are operable to assign work to one or more work performers 12. Work performers 12 operate in a load-sharing manner so that any one work performer 12 does not become overwhelmed with work.

In systems that have processing nodes that have dis-similar processing capacities, traditional static load balancing methods do not take full advantage of the higher processing power of the processors. Typically, the processing capacity of processing nodes are used to execute operating system and application support software, standby applications, active applications, and load-shared applications. The amount of processing capacity used for these applications typically vary among the processing nodes because different set of applications may run on different processing nodes, which may also change over time. The processing capacities used for the applications are also different due to the different processing power of the nodes. Therefore, assigning a discrete unit of work to one processing node may cause its work load to change by X%, while the same unit of work may cause another processing node to change its work load by Y%. Therefore, load balancing methods that rely on units of work or a round robin scheme do not fully exploit the higher processing power of newer processing nodes.

In an embodiment of the present invention, the work load is shared among work performers 12 so that each work performer 12 functions at more or less an equal percentage of its own full capacity. Work originators 10 and work performers 12 communicate by inter-node messaging. In the present invention, the status of each work performer's work load is inserted into each inter-node message originating from that work performer destined for a work originator. Each work originator 10

maintains a record of all work performer's current load condition and consults this record whenever work needs to be assigned to a work performer. On the basis of the work load record, a work performer is selected and assigned the new work. This load balancing scheme is an open loop feedback design that dynamically assigns work based on the percentage of capacity available to do the work at each work performer. Details of the invention are described below.

FIGURE 2 is a simplified block diagram of a distributed processing system 20 set in a telecommunications environment. In particular, system 20 is an integrated media switching platform. System 20 includes work originators 10, which are multi-service fabric (MSF) 24 and signaling gateways (SGW) 26. System 20 also includes work performers 12, which are multi-service controllers (MSC) 30 coupled to work originators 10 via networks, network servers and/or network switches 28. Network servers 28 may be Ethernet switches, for example. Work originators 10 interface with public switched telephone network (PSTN) 32, asynchronous transfer mode (ATM) network 34, customer premises equipment (CPE) such as a private branch exchange (PBX) 36, integrated digital loop carrier (IDLC) 38, simple network management protocol (SNMP) network management system (NMS) 40, user interface (I/F) 42, and other network nodes. As voice or data calls are being originated, work originators 10 select a work performer 12 to handle the call based on its current work load. The work load is distributed so that the work performers all perform at substantially the same percentage of each processor's full capacity.

FIGURE 3 is a flowchart of node occupancy value calculation according to an embodiment of the teachings of the present invention. Each work performer is operable to calculate or otherwise determine its own occupancy rate or value. In one embodiment, the node occupancy value is determined on a periodic basis, as shown in block 60. If it is time to calculate or determine the current occupancy value, then it is calculated according to a predefined method or formula, as shown in block 62. A combination of percentage of processor occupancy and the length of the incoming work queue are factors that can be used to calculate the occupancy value. For example, a processing node may calculate its node occupancy value by:

*Processor_Occupancy% * n + Pending Queue_Length*m,*

where n and m are tuning factors; for example, n=.8 and m=1 in one embodiment. On the other hand, another processing node may be instructed to output a high occupancy value rather than to make a true determination in order to keep out new work because it is currently testing a new software load, for example. All processing nodes in a system may use the same calculation method, or different processing nodes may use different methods in the manner best suited to each individual node. As a further example, the occupancy value calculation may provide hysteresis to smooth the resultant output to avoid large swings in the node occupancy value. The newly determined node occupancy value is then stored or used to update a known memory location, as shown in block 64.

FIGURE 4 is a flowchart of sending an inter-node message containing a node occupancy value according to an embodiment of the teachings of the present invention. A work performer, during the normal course of events, communicates with work originators by sending inter-node messages. For every message a work performer sends, it sends a status of its current work load. In blocks 70 and 72, the work performer reads the current node occupancy value and insert the value into a appropriate predetermined location or field in the message header of an inter-node message. Also included in the header is sender ID or address and recipient ID or address. The message is then sent to the destination, as shown in block 74. In this manner, the recipient of the message is provided a current status of the work load of the sender work performer.

FIGURE 5 is a flowchart of receiving an inter-node message containing a node occupancy value according to an embodiment of the teachings of the present invention. A work originator receives an inter-node message from another node or a work performer, as shown in block 80. The work originator extracts the node occupancy value from the predefined field in the message header as well as the sender node's unique ID or address, as shown in block 82. The node occupancy value is then stored in a node occupancy table indexable by the node IDs, as shown in block 84. The node occupancy table is stored in the respective memory of each work originator node.

FIGURE 6 is a flowchart of selecting a processing node according to the node occupancy values according to an embodiment of the teachings of the present invention. A work originator receives work from an external source or another node in the network, as shown in block 90. For example, work may be in the form of signaling data and voice data for a telephony call received by multi-service fabric 24 and signaling gateway 26. As part of the process of selecting a work performer to handle the work, the work originator reads the node occupancy table to determine which work performer(s) is(are) capable of handling the work and is(are) among the lowest in terms of occupancy status, and sends the work to the selected node(s), as shown in blocks 92 and 94. In one exemplary embodiment, the work originator may randomly select a node from the lowest occupied third of the available processing nodes. The work performer then sends a request to the selected work performer to perform the task. For example, multi-service fabric 24 prepares and sends a call setup message to the selected work performer so that it may handle the incoming call.

When the work performer is chosen in this manner, the dynamic work processing load for each work performer as a percentage or relative to the total capacity is taken into account. As a result, the work load can be more evenly and more intelligently distributed to fully take advantage the higher capacity of newer and faster work performers. Because the node occupancy information is communicated in the message header of existing message traffic, little or no overhead is expended to accomplish this task. The use of an open loop feedback design versus a closed loop feedback design provides a more flexible load balancing scheme. Each node in the system is capable of calculating its own occupancy rate in the manner best suited to that node or best for overall system performance.

While the invention has been particularly shown and described by the foregoing detailed description, it will be understood by those skilled in the art that various changes, alterations, modifications, mutations and derivations in form and detail may be made without departing from the spirit and scope of the invention.

WHAT IS CLAIMED IS:

1. A method of dynamically balancing work among a plurality of processing nodes, comprising:

periodically updating a node occupancy value at each of the plurality of processing nodes;

communicating the respective node occupancy value of each processing node to at least one work originator node;

storing the node occupancy values of the plurality of processing nodes at the at least one work originator node;

selecting, by the at least one work originator node, a processing node to perform a particular task in response to the node occupancy values of the processing nodes.

2. The method, as set forth in claim 1, wherein periodically updating node occupancy value comprises calculating the node occupancy value, by each of the plurality of processing nodes, using a percentage of available processing capacity of the processing node.

3. The method, as set forth in claim 1, wherein periodically updating node occupancy value comprises calculating the node occupancy value, by each of the plurality of processing nodes, using a combination of a percentage of available processing capacity of the processing node and a length of its work queue.

4. The method, as set forth in claim 1, wherein periodically updating node occupancy value comprises calculating the node occupancy value, by each of the plurality of processing nodes, using a combination of a percentage of available processing capacity of the processing node, a length of its work queue, and its processing speed.

5. The method, as set forth in claim 1, wherein communicating the respective node occupancy value comprises:

inserting the respective node occupancy value into a message header of a message; and

sending the message to the work originator node.

6. The method, as set forth in claim 1, wherein communicating the respective node occupancy value comprises sending a message containing the respective node occupancy value as a part of existing message traffic.

7. The method, as set forth in claim 1, wherein communicating the respective node occupancy value comprises:

inserting the respective node occupancy value and a sender ID into a message header of a message; and

sending the message to the work originator node.

8. The method, as set forth in claim 7, wherein storing the node occupancy values of the plurality of processing nodes comprises storing the node occupancy value in a table indexable by the sender ID.

9. The method, as set forth in claim 1, wherein selecting a processing node comprises:

determining a subset of processing nodes having lowest node occupancy values; and

selecting a processing node from the subset.

10. The method, as set forth in claim 1, wherein selecting a processing node comprises:

determining a subset of processing nodes having the lowest third node occupancy values; and

selecting a processing node from the subset.

11. A method of dynamically balancing call processing tasks among a plurality of call processing nodes in a telecommunications switch, comprising:

periodically updating a node occupancy value at each of the plurality of call processing nodes;

communicating the respective node occupancy value of each call processing node to at least one work originator node operable to receive incoming calls;

storing the node occupancy values of the plurality of call processing nodes at the at least one work originator node;

selecting, by the at least one work originator node, a call processing node to process the incoming call in response to the node occupancy values of the call processing nodes.

12. The method, as set forth in claim 11, wherein periodically updating node occupancy value comprises calculating the node occupancy value, by each of the plurality of call processing nodes, using a percentage of available processing capacity of the call processing node.

13. The method, as set forth in claim 11, wherein periodically updating node occupancy value comprises calculating the node occupancy value, by each of the plurality of call processing nodes, using a combination of a percentage of available processing capacity of the call processing node and a length of its work queue.

14. The method, as set forth in claim 11, wherein periodically updating node occupancy value comprises calculating the node occupancy value, by each of the plurality of call processing nodes, using a combination of a percentage of available processing capacity of the call processing node, a length of its work queue, and its processing speed.

15. The method, as set forth in claim 11, wherein communicating the respective node occupancy value comprises:

inserting the respective node occupancy value into a message header of a call processing message; and

sending the message to the work originator node.

16. The method, as set forth in claim 11, wherein communicating the respective node occupancy value comprises sending a call processing message containing the respective node occupancy value as a part of existing call processing message traffic.

17. The method, as set forth in claim 11, wherein communicating the respective node occupancy value comprises:

inserting the respective node occupancy value and a sender ID into a message header of a call processing message; and

sending the call processing message to the work originator node.

18. The method, as set forth in claim 17, wherein storing the node occupancy values of the plurality of call processing nodes comprises storing the node occupancy value in a table indexable by the sender ID.

19. The method, as set forth in claim 11, wherein selecting a call processing node comprises:

determining a subset of call processing nodes having lowest node occupancy values; and

randomly selecting a call processing node from the subset.

20. The method, as set forth in claim 11, wherein selecting a call processing node comprises:

determining a subset of call processing nodes having the lowest third node occupancy values; and

randomly selecting a call processing node from the subset.

21. A telecommunications system, comprising:

a plurality of call processing nodes;

at least one incoming call receiving node;

the plurality of call processing nodes each:

periodically calculating and updating a respective node occupancy value; and

communicating the respective node occupancy value to at least one incoming call receiving node;

the at least one incoming call receiving node:

storing the node occupancy values of the plurality of call processing nodes; and

selecting a call processing node to process the incoming call in response to the stored node occupancy values of the call processing nodes.

22. The telecommunications system, as set forth in claim 21, wherein the plurality of call processing nodes calculates the respective node occupancy value using a percentage of available processing capacity of the call processing node.

23. The telecommunications system, as set forth in claim 21, wherein the plurality of call processing nodes calculate the respective node occupancy value using a combination of a percentage of available processing capacity of the call processing node and a length of its work queue.

24. The telecommunications system, as set forth in claim 21, wherein the plurality of call processing nodes insert the respective node occupancy value into a message header of a call processing message, and send the message to the incoming call receiving node.

25. The telecommunications system, as set forth in claim 21, wherein the plurality of call processing nodes send a call processing message containing the respective node occupancy value as a part of existing call processing message traffic.

26. The telecommunications system, as set forth in claim 21, wherein the plurality of call processing nodes insert the respective node occupancy value and a sender ID into a message header of a call processing message, send the call processing message to the incoming call receiving node.

27. The telecommunications system, as set forth in claim 26, wherein the at least one incoming call receiving node stores the node occupancy value in a table indexable by the sender ID.

28. The telecommunications system, as set forth in claim 21, wherein the at least one incoming call receiving node determines a subset of call processing nodes having lowest node occupancy values, and randomly selects a call processing node from the subset.

29. The telecommunications system, as set forth in claim 21, wherein the at least one incoming call receiving node determines a subset of call processing nodes having the lowest third node occupancy values, and randomly selects a call processing node from the subset.

SYSTEM AND METHOD OF DYNAMIC LOAD BALANCING ACROSS PROCESSOR NODES

ABSTRACT OF THE INVENTION

A method of dynamically balancing work among a plurality of processing nodes is provided. The method includes the steps of periodically updating a node occupancy value at each of the plurality of processing nodes, communicating the respective node occupancy value of each processing node to at least one work originator node, storing the node occupancy values of the plurality of processing nodes at the at least one work originator node, and selecting, by the at least one work originator node, a processing node to perform a particular task in response to the node occupancy values of the processing nodes.

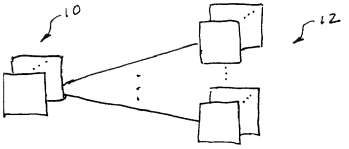
10
12

FIG. 1

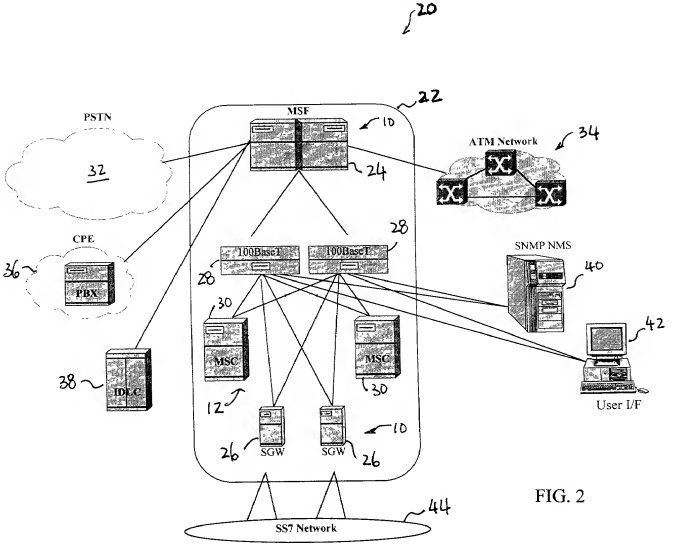
20
22
MSF
10
PSTN
32
24
ATM Network
34
28
100BaseT
100BaseT
CPE
36
PBX
SNMP NMS
40
28
30
MSC
MSC
30
42
User I/F
38
IDLC
12
10
26
SGW
SGW
26
44
SS7 Network

FIG. 2

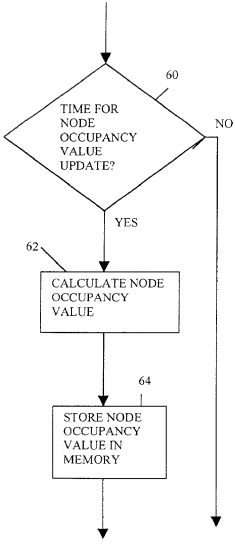
60
TIME FOR NODE OCCUPANCY VALUE UPDATE?
NO
YES
62
CALCULATE NODE OCCUPANCY VALUE
64
STORE NODE OCCUPANCY VALUE IN MEMORY

FIG. 3

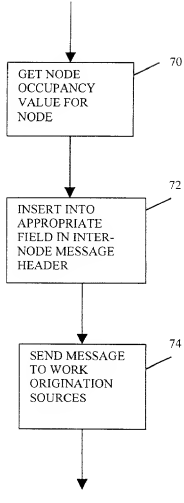
70
GET NODE OCCUPANCY VALUE FOR NODE
72
INSERT INTO APPROPRIATE FIELD IN INTER-NODE MESSAGE HEADER
74
SEND MESSAGE TO WORK ORIGINATION SOURCES

FIG. 4

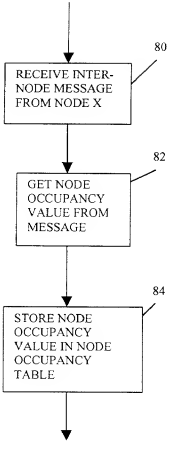
80
RECEIVE INTER-NODE MESSAGE FROM NODE X
82
GET NODE OCCUPANCY VALUE FROM MESSAGE
84
STORE NODE OCCUPANCY VALUE IN NODE OCCUPANCY TABLE

FIG. 5

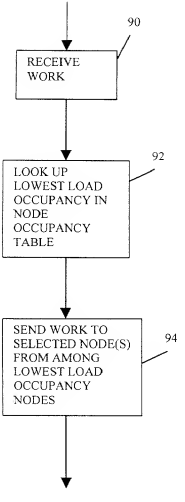
90
RECEIVE WORK
92
LOOK UP LOWEST LOAD OCCUPANCY IN NODE OCCUPANCY TABLE
94
SEND WORK TO SELECTED NODE(S) FROM AMONG LOWEST LOAD OCCUPANCY NODES

FIG. 6

COMBINED DECLARATION AND POWER OF ATTORNEY

(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL, CONTINUATION, OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is for an original application.

INVENTORSHIP IDENTIFICATION

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am an original, first and joint inventor of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTION

System and Method of Dynamic Load Balancing Across Processor Nodes

SPECIFICATION IDENTIFICATION

The specification is attached hereto.

ACKNOWLEDGMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, Section 1.56, and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent.

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

APPOINTED PRACTITIONER(S)	REGISTRATION NUMBER(S)
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I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.

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DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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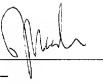
Inventor's signature 
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